

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: TAKASHIMA, Masayuki et al. Conf.:
Appl. No.: NEW Group:
Filed: December 21, 2001 Examiner:
For: POLISHING PAD, POLISHING APPARATUS AND
POLISHING METHOD USING THE SAME

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

December 21, 2001

Sir:

The following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

IN THE SPECIFICATION:

Please replace the paragraph beginning on page 2, line 1, with the following rewritten paragraph:

--In conventional CMP of a metal film, it is general to conduct polishing while feeding a polishing slurry containing abrasive particles into between a polishing subject and a polishing pad. However, in this method, the surface of a metal film is scratched and roughened, abrasive are embedded in a metal film, and

further, a slurry has to be discarded. Therefore, it is investigated to conduct CMP by a pad itself without using a polishing slurry. As the polishing pad used of CMP, a complex called non-woven fabric type composed of polyester fiber and polyurethane resin, and a porous polyurethane resin, and the like are usually used.--

Please replace the paragraph abridging pages 7 and 8, with the following rewritten paragraph:

--As the cation exchange fiber, for example, cation ion exchange fibers having $-SO_3M$ (M has the same definition as described above) derived from sulfonic acids or salts of sulfonic acids and $-COOM$ (M has the same definition as described above) derived from carboxylic acids or salts of carboxylic acids, as a functional group, and containing polyvinyl alcohol and the like as a substrate are listed.--

Please replace the following paragraphs beginning on page 8, line 7, with the following rewritten paragraphs:

--As the anion exchange fiber, for example, anion exchange fibers having an amino group, mono-substituted amino group, di-substituted amino group and the like, s a functional group, and containing polyvinyl alcohol and the like as a substrate are listed.

As the chelate fiber, those having an aminocarboxylic acid, aminophosphonic acid, imino diacetic acid and the like, as a functional group, and containing the substrate s that of the ion exchange fiber are listed.--

Please replace the paragraph abridging pages 8 and 9, with the following rewritten paragraph:

--Further, a resin having no functional group capturing a metal ion may be processed into a sheet to which then a functional group is introduced. Known methods can be used for introducing the functional group. For example, methods in which the surface of an olefin-based resin such as polyethylene, polypropylene and the like, a polyurethane resin, a polyimide resin, epoxy resin, polysulfone resin and the like is irradiated with an ionizing radiation to introduce an ion exchange group (for example, radiation graft polymerization method), methods of introducing a functional group by immersing activated carbon fiber sheet or multifilament of long fiber, spun thread of short fiber, woven or knitted cloth thereof, unwoven cloth, fiber obtained by combining or mix-spinning two or more fibers, vegetable fibers such as cellulose fiber and the like, into a drug solution, and other methods are listed. Further, a functional group may be introduced by addition reaction of a compound having a functional group in

producing a polyurethane resin, polyimide resin, epoxy resin, polysulfone resin and the like, and the resulted resin may be processed into a sheet which is used as a pad.--

Please replace the paragraph beginning on page 17, line 6, with the following rewritten paragraph:

--Further, the polishing apparatus in the present invention preferably comprises a regenerating agent which regenerate a functional group deactivated by capturing a metal ion, and a functional group regeneration treatment apparatus which allows a regeneration agent to contact with a polishing pad after polishing. Regeneration of functional group means releasing of a metal ion from a functional group arrested a metal ion, and indicated recovering of an ability of functional group of capturing a metal ion.--

Please replace the paragraph beginning on page 18, line 19, with the following rewritten paragraph:

--The polishing method of the present invention is a method of polishing a metal by chemical mechanical polishing, and is characterized in that it uses the above-mentioned pad and apparatus of the present invention as a polishing pad and a polishing apparatus, respectively. The polishing method of the

present invention can be preferably applied to metal films, particularly, to metal films formed on a semiconductor substrate, of them, to a copper film.--

Please replace the paragraph beginning on page 20, line 2, with the following rewritten paragraph:

--A copper plate was polished in the same manner as in Comparative example 1 except that a polyurethane resin-impregnated polyester non-woven fabric SUBA400 (trade name: manufactured by Rodel) was used instead of the pad having an imino diacetic acid group, as a polishing pad. The copper plate had a polishing speed of 34 Å/minute.

REMARKS

Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly solicited.

Attached hereto is a marked-up version of the changes made to the application by this Amendment.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By  #3288

~~S~~ Raymond C. Stewart, #21,066

RCS/sll
2185-0599P
Attachments

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(Rev. 12/19/01)

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

The paragraph beginning on page 2, line 1, has been amended as follows:

--In conventional CMP of a metal film, it is general to conduct polishing while feeding a polishing slurry containing abrasive particles into between a polishing subject and a polishing pad. However, in this method, the surface of a metal film is scratched and roughened, abrasive are embedded in a metal film, and further, a slurry has to be discarded. Therefore, it is investigated to conduct CMP by a pad itself without using a polishing slurry. As the polishing pad used of CMP, a complex called non-woven fabric type composed of polyester [fibbed]fiber and polyurethane resin, and a porous polyurethane resin, and the like are usually used.--

The paragraph beginning on page 7, line 23, has been amended as follows:

--As the cation exchange [resin]fiber, for example, cation ion exchange [resins]fibers having $-\text{SO}_3\text{M}$ (M has the same definition as described above) derived from sulfonic acids or salts of sulfonic

acids and -COOM (M has the same definition as described above) derived from carboxylic acids or salts of carboxylic acids, as a functional group, and containing polyvinyl alcohol and the like as a substrate are listed.--

The paragraph beginning on page 8, line 7, has been amended as follows:

--As the anion exchange [resin]fiber, for example, anion exchange [resins]fibers having an amino group, mono-substituted amino group, di-substituted amino group and the like, s a functional group, and containing polyvinyl alcohol and the like as a substrate are listed.--

The paragraph beginning on page 8, line 12, has been amended as follows:

--As the chelate [resin]fiber, those having an aminocarboxylic acid, aminophosphonic acid, imino diacetic acid and the like, as a functional group, and containing the substrate s that of the ion exchange fiber are listed.--

The paragraph beginning on page 8, line 20, has been amended as follows:

--Further, a resin having no functional group capturing a metal ion may be processed into a sheet to which then a functional group is introduced. Known methods can be used for introducing the functional group. For example, methods in which the surface of an olefin-based resin such as polyethylene, polypropylene and the like, a polyurethane resin, a polyimide resin, epoxy resin, polysulfone resin and the like is irradiated with an ionizing radiation to introduce an ion exchange group (for example, radiation graft polymerization method), methods of introducing a functional group by immersing activated carbon fiber [sheer]sheet or multifilament of long fiber, spun thread of short fiber, woven or knitted cloth thereof, unwoven cloth, fiber obtained by combining or mix-spinning two or more fibers, vegetable fibers such as cellulose fiber and the like, into a drug solution, and other methods are listed. Further, a functional group may be introduced by addition reaction of a compound having a functional group in producing a polyurethane resin, polyimide resin, epoxy resin, polysulfone resin and the like, and the resulted resin may be processed into a sheet which is used as a pad.--

The paragraph beginning on page 17, line 6, has been amended as follows:

--Further, the polishing apparatus in the present invention preferably comprises a [polishing subject]regeneration agent which regenerates a functional group deactivated by capturing a metal ion, and a functional group regeneration treatment apparatus which allows a regeneration agent to contact with a polishing pad after polishing. Regeneration of functional group means releasing of a metal ion from a functional group arrested a metal ion, and indicates recovering of an ability of functional group of capturing a metal ion.--

The paragraph beginning on page 18, line 19, has been amended as follows:

--The polishing method of the present invention is a method of polishing a metal by chemical mechanical polishing, and is characterized in that it uses the above-mentioned pad and apparatus of the present invention as a polishing pad and a polishing apparatus, respectively. The polishing method of the present invention can be preferably applied to metal films, particularly, to metal films formed on a semiconductor substrate, of them, to a [metal]copper film.--

The paragraph beginning on page 20, line 2, has been amended as follows:

--A copper plate was polished in the same manner as in Comparative example 1 except that a polyurethane resin-impregnated polyester non-woven fabric SUBA400 (trade name: manufactured by Rodel) was used instead of the pad having an imino diacetic acid group, as a polishing pad. The copper plate had a polishing speed of 34 Å/minute.